Claims:

1. A method of forming an image from millimetre waves, said method including the steps of:

scanning a field of view using two geometrically orthogonal, intersecting co-polarized fan beams to receive millimetre wave radiation; and

cross-correlating components of said received millimetre wave radiation from said fan beams.

2. The method according to claim 1, wherein polarizations of the electric fields of said two fan beams are arranged to be substantially parallel in alignment.

3. The method according to claim 2, further including the step of polarization rotation filtering of said millimetre wave radiation received in one of said fan beams.

4. The method according to claim 1, wherein said scanning step is performed in azimuth and elevation defining a scan range, and an intersection region of said two fan beams is able to cover any point in said scan range.

5. The method according to claim 4, wherein said scan range determines said field of view and a beam width of each fan-beam in a narrow direction determines an angular resolution of said image.

6. The method according to claim 1, further including the step of measuring said cross-correlated output at each point in said field of view to produce a map of brightness.

7. The method according to claim 6, further including the step of controlling said two geometrically orthogonal, intersecting fan beams to generate said cross-correlated output at each fan beam intersection point in said field of view.

8. The method according to claim 1, wherein said scanning step is implemented using a dual fan-beam antenna.

9. The method according to claim 8, wherein said dual fan-beam antenna has two modified pill-box antennas and a polarization rotator to change the direction of incident polarization for one of said modified pill-box antennas.

10. An apparatus for forming an image from millimetre waves, said apparatus including:

an antenna for scanning a field of view using two geometrically orthogonal, intersecting co-polarized fan beams to receive millimetre wave radiation; and

a receiver for cross-correlating components of said received millimetre wave radiation from said fan beams.

11. The apparatus according to claim 10, wherein polarizations of the electric fields of said two fan beams is arranged to be substantially parallel in alignment.

12. The apparatus according to claim 11, further including a polarization rotation filter for said millimetre wave radiation received in one of said fan beams.

13. The apparatus according to claim 10, wherein scanning by said antenna is performed in azimuth and elevation defining a scan range, and an intersection region of said two fan beams is able to cover any point in said scan range.

14. The apparatus according to claim 13, wherein said scan range determines said field of view and a beam width of each fan-beam in a narrow direction determines an angular resolution of said image.

15. The apparatus according to claim 10, further including a processor for measuring said cross-correlated output at each point in said field of view to produce a map of brightness.

16. The apparatus according to claim 15, further including a controller for controlling said two geometrically orthogonal, intersecting fan beams to generate said cross-correlated output at each fan beam intersection point in said field of view.

17. The apparatus according to claim 10, wherein said antenna is a dual fan-beam antenna.

18. The apparatus according to claim 17, wherein said dual fan-beam antenna has two modified pill-box antennas and a polarization rotator to change the direction of incident polarization for one of said modified pill-box antennas.

19. A method of receiving millimetre wave radiation, said method including the steps of:

scanning a field of view using a fan beam to receive millimetre wave radiation;

rotating polarization of incident millimetre wave radiation through 90 degrees; and

scanning said field of view using another fan beam to receive said polarization-rotated millimetre wave radiation, said fan beams intersecting and being geometrically orthogonal to each other, and said radiation being co-polarized.

20. The method according to claim 19, wherein said fan beams are provided by respective fan beam antennas, each including a modified pill-box antenna.

21. The method according to claim 20, wherein said modified pill-box antenna includes:

a metal housing with an elongated aperture in at least one side of said housing;

a curved primary reflector surface located within said housing and opposite said aperture;

a feed horn within said housing; and

one or more sub-reflectors for coupling said feed horn to said primary reflector surface, at least one of said sub-reflectors being designed to rotate and providing one-dimensional beam scanning in a narrow direction of said other fan beam.

22. The method according to claim 19, wherein said rotating step is implemented using a polarization rotating transreflector including:

a planar metallic reflector; and

a grid of closely spaced wires, said grid spaced $n \times \lambda/4$ from said planar metallic

reflector, where n is an odd integer and λ is a wavelength of said millimetre wave radiation.

23. The method according to claim 22, wherein said polarization rotating transreflector is positioned at a 45 degree angle relative to an aperture of said other fan beam antenna and at substantially 45 degrees relative to the direction of incident millimetre-wave radiation.

24. An antenna for receiving millimetre wave radiation, said antenna including:

a fan beam antenna for receiving millimetre wave radiation by scanning a field of view using a first fan beam;

a filter for rotating polarization of incident millimetre wave radiation through 90 degrees; and

another fan beam antenna for receiving said polarization-rotated millimetre wave radiation by scanning a field of view using a second fan beam, said fan beams intersecting and being geometrically orthogonal to each other, and said radiation being co-polarized.

25. The antenna according to claim 24, wherein said fan beam antennas each include a modified pill-box antenna.

26. The antenna according to claim 25, wherein said modified pill-box antenna includes:

a metal housing with an elongated aperture in at least one side of said housing;

a curved primary reflector surface located within said housing and opposite said aperture;

a feed horn within said housing; and

one or more sub-reflectors for coupling said feed horn to said primary reflector surface, at least one of said sub-reflectors being designed to rotate and providing one-dimensional beam scanning in a narrow direction of said other fan beam.

27. The antenna according to claim 24, wherein said polarization rotating filter is a polarization rotating transreflector including:

a planar metallic reflector; and

a grid of closely spaced wires, said grid spaced n×λ/4 from said planar metallic reflector, where n is an odd integer and λ is a wavelength of said millimetre wave radiation.

28. The antenna according to claim 27, wherein said polarization rotating transreflector is positioned at a 45 degree angle relative to an aperture of said other fan beam antenna and at a substantially 45 degree angle relative to the direction of incident millimetre-wave radiation.

29. A method of receiving millimetre wave radiation for generating an image, said method including the steps of:

receiving millimetre wave radiation in accordance with first and second fan beams, wherein said first and second fan beams are geometrically orthogonal to each other and intersecting, said millimetre wave radiation received in accordance with said second fan beam being co-polarized with said millimetre wave radiation received in accordance with said first fan beam;

downconverting components of said millimetre wave radiation received in accordance with said first and second beams to generate respective intermediate frequency (IF) signals;

cross-correlating said IF signals; and

filtering the resulting cross-correlated signal to provide a value proportional to brightness at each point in the scene.

30. The method according to claim 29, further including the step of amplifying said received millimetre wave radiation in accordance with said first and second beams prior to said step of downconverting.

31. An apparatus for receiving millimetre wave radiation for generating an image, said apparatus including:

a receiver for receiving millimetre wave radiation in accordance with first and second fan beams, wherein said first and second fan beams are geometrically orthogonal to each other and intersecting, said millimetre wave radiation received in accordance with said second fan beam being co-polarized with said millimetre wave radiation received in

accordance with said first fan beam;

a downconverter for downconverting components of said millimetre wave radiation received in accordance with said first and second beams to generate respective intermediate frequency (IF) signals;

a correlator for cross-correlating said IF signals; and

a filter for filtering the resulting cross-correlated signal to provide a value proportional to brightness at each point in the scene.

32. The apparatus according to claim 31, further including an amplifier for amplifying said received millimetre wave radiation in accordance with said first and second beams prior to downconverting.

33. A millimetre wave imaging method, said method including the steps of:

receiving millimetre wave radiation, said receiving step including:

receiving millimetre wave radiation by scanning a field of view using a fan beam;

rotating polarization of incident millimetre wave radiation through 90 degrees; and

receiving said polarization rotated millimetre wave radiation by scanning a field of view using another fan beam, said fan beams intersecting and being geometrically orthogonal to each other;

processing said received millimetre wave radiation, said processing step including:

receiving components of millimetre wave radiation from said antenna received in accordance with said fan beams;

downconverting respective components of said received millimetre wave radiation received to generate respective intermediate frequency (IF) signals;

cross-correlating said IF signals; and

filtering the resulting cross-correlated signal to produce a filtered, cross-correlated signal proportional to brightness at each point in said field of view as said antenna beams are scanned;

building up said image using said filtered, cross-correlated signal.

34. The method according to claim 33, further including the step of independently controlling the scanning of said antenna, as required, so that said image can be generated from said filtered, cross-correlated signal, which provides a value proportional to the brightness of the scene at each point in the field of view.

35. A millimetre wave imaging system, including:

means for receiving millimetre wave radiation, said receiving means including:

a fan beam antenna for receiving millimetre wave radiation by scanning a field of view using a fan beam;

means for rotating polarization of incident millimetre wave radiation through 90 degrees; and

another fan beam antenna for receiving said polarization rotated millimetre wave radiation by scanning a field of view using another fan beam, said fan beams intersecting and being geometrically orthogonal to each other;

a millimetre wave receiver coupled to said antenna, including:

first and second receivers respectively coupled to said fan beam antennas respectively for receiving millimetre wave radiation in accordance with said fan beams;

downconverters for downconverting respective components of said received millimetre wave radiation received from said first and second receivers to generate respective intermediate frequency (IF) signals;

a correlator for cross-correlating said IF signals; and

a filter for filtering the resulting cross-correlated signal to produce a filtered, cross-correlated signal proportional to brightness in said field of view as said antenna beams are scanned;

a processing unit for building up said image using said filtered, cross-correlated signal.

36. The system according to claim 33, wherein said processing unit independently produces control signals for scanning said antenna, as required, so that said

image can be generated from said filtered, cross-correlated signal, which provides a value proportional to the brightness of the scene at each point in the field of view.